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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/792,218 | 03/04/2004 | Masahiro Satoh | Q80204 | 4155 |

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| EXAMINER | |
|---|---|
| COHEN, AMY R | |

| ART UNIT | PAPER NUMBER |
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| 2859 | |

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DATE MAILED: 08/22/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) |
|---|---|---|
| | 10/792,218 | SATOH ET AL. |
| | Examiner | Art Unit |
| | Amy R. Cohen | 2859 |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *08 June 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1,3,5-7,9-13,15,17-19 and 21-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,5-7,9-13,15,17-19 and 21-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *04 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

## DETAILED ACTION

### *Claim Objections*

1. Claims 1, 7, 11-13, 19, 23-28 are objected to because of the following informalities:

Claims 1, 7, 11-13, 19, 23-28 contain the symbol α in the matrix expressions, however, in the body of the claim, the symbol ά is used.

Appropriate correction is required.

2. Claims 11, 23, 27 are objected to because of the following informalities:

Claims 11, 23, and 27 discuss the apparatus, method and computer product wherein a first-axis, a second axis, a y-axis, and a z-axis geomagnetic forces are detected. Since there are only three axes present in the basic system, one of the geomagnetic force detectors is being redundantly claimed. The claim language regarding the geomagnetic force calculator is also confusing since the calculator "calculates the force along an axis other than the first axis and the second axis", which is now not necessary, since all axes have a geomagnetic force detector as previously claimed in the claim language.

Appropriate correction is required.

### *Claim Rejections - 35 USC § 102*

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 3, 5-7, 9-13, 15, 17-19, 21-28 are rejected under 35 U.S.C. 102(b) as being anticipated by Hansen et al. (U. S. Patent No. 5,953,683).

Regarding Claims 1, 3, 5, 6: Hansen et al. teaches a directional measuring device that measures a direction of a body of the directional measuring device in a three-dimensional space including and X-axis indicating magnetic north on a horizontal plane, a Y-axis orthogonal to the X-axis on the horizontal plane, and a Z-axis orthogonal to the horizontal plane, assuming that the body points towards an a-axis, comprising: an x-axis geomagnetic force detector (11', 13') that detects a geomagnetic force along the x-axis; an x-axis tilt detector (33, 35) that detects an x-axis tilt angle that is an angle between the horizontal plane and the x-axis;; a y-axis geomagnetic force detector (11', 15') that detects a geomagnetic force along a y-axis that is orthogonal to the x-axis; a z-axis geomagnetic force detector (11', 17') that detects a geomagnetic force along a z-axis that is orthogonal to both the x-axis and the y-axis; a determining unit (25') that determines the x-axis tilt angle as a rotation angle that is an angle by which the x-axis needs to be rotated around the Y-axis so as to be in the horizontal plane; a rotation angle calculator (Fig. 10) that calculated a rotation angle based on the x-axis tilt angle and the y-axis tilt angle wherein the rotation angle is an angle by which the y-axis needs to be rotated around the X-axis so as to be in the horizontal plane when the x-axis is rotated by the x-axis by the x-axis tilt angle around the Y-axis so as to be in the horizontal plane to cause the y-axis to rotate following rotation of the x-axis (Fig. 9), and an azimuth calculator (25', Fig. 10) that calculates an azimuth of the body based on the geomagnetic force and the rotation angle, wherein the azimuth calculator calculates an azimuth of the body based on the geomagnetic forces detected by both the y-axis geomagnetic force detector and the z-axis geomagnetic force detector and the rotation angle calculated, and the rotation angle calculator calculates the rotation angle based on a coordinate expression for rotations three times expressed by an expression wherein $\alpha$ is a rotation angle around the X-axis,

$\beta$ is an x-axis tilt angle as a rotation angle around the Y-axis, and $\theta$ is a rotation angle around the Z-axis as an azimuth of the body (Col 7, line 41-Col 8, line 20).

Hansen et al. teaches the directional measuring device wherein the azimuth calculator further comprises: a sine calculator that calculates sine of the azimuth of the body based on the geomagnetic forces detected by both the y-axis geomagnetic force detector and the z-axis geomagnetic force detector and the rotation angle calculated by the rotation angle calculator; a cosine calculator that calculates cosine of the azimuth of the body based on the geomagnetic force detected by the x-axis geomagnetic force detector and the rotation angle determined by the determining unit; and an identifying unit that identifies an angular range of the azimuth based on the sine and the cosine of the azimuth, wherein the azimuth calculator calculates the azimuth based on one among the sine and the cosine of the azimuth and a tangent value, and of the angular range identified by the identifying unit, the tangent being obtained from the sine and the cosine (Figs. 10-12).

Hansen et al. teaches the directional measuring device wherein the azimuth angle calculator further comprises: a dip input unit that receives a dip between a geomagnetic vector at a present position of the body and the horizontal plane, wherein the azimuth calculator calculates the azimuth based on the dip (Col 6, lines 33-67 and Col 9, lines 17-35).

Hansen et al. teaches the directional measuring device wherein the azimuth angle calculator further comprises: a declination input unit that receives a declination between the magnetic north at a present position of the body and the true north, wherein the azimuth calculator calculates the azimuth based on the declination (Col 6, lines 33-67 and Col 9, lines 17-35).

Regarding claims 7, 9, 10: Hansen et al. teaches a directional measuring device that measures a direction of a body of the directional measuring device in a three-dimensional space including an X-axis indicating magnetic north on a horizontal plane, a Y-axis orthogonal to the X-axis on the horizontal plane, and a Z-axis orthogonal to the horizontal plane, assuming that the body points towards an x-axis, comprising; a y-axis geomagnetic force detector (11', 15') that detects a geomagnetic force along a y-axis that is orthogonal to the x-axis; a z-axis geomagnetic force detector (11', 17') that detects a geomagnetic force along a z-axis that is orthogonal to both the x-axis and the y-axis; an x-axis tilt angle detector (33, 35) that detects an x-axis tilt angle that is an angle between the horizontal plane and the x-axis; a y-axis tilt angle detector (33, 37) that detects a y-axis tilt angle that is angle between the horizontal plane and the y-axis; a rotation angle calculator that calculates a rotation angle based on both the x-axis tilt angle and the y-axis tilt angle, wherein the rotation angle is an angle by which the y-axis needs to be rotated around the X-axis so as to be in the horizontal plane when the x-axis is rotated by the x-axis tilt angle around the Y-axis so as to be in the horizontal plane to cause the y-axis to rotate following rotation of the x-axis; and an azimuth calculator (25') that calculates an azimuth of the body based on the geomagnetic forces detected by both the y-axis geomagnetic force detector and the z-axis geomagnetic force detector and the rotation angle (Figs. 10-12 and Col 6, line 33-Col 7, line 25), where the rotation angle calculator calculates the rotation angle based on a coordinate expression for rotations three times expressed by an expression wherein $\alpha$ is a rotation angle around the X-axis, $\beta$ is an x-axis tilt angle as a rotation angle around the Y-axis, and $\theta$ is a rotation angle around the Z-axis as an azimuth of the body (Col 7, line 41-Col 8, line 20).

Hansen et al. teaches the directional measuring device wherein the azimuth angle calculator further comprises: a dip input unit that receives a dip between a geomagnetic vector at

a present position of the body and the horizontal plane, wherein the azimuth calculator calculates the azimuth based on the dip (Col 6, lines 33-67 and Col 9, lines 17-35).

Hansen et al. teaches the directional measuring device wherein the azimuth angle calculator further comprises: a declination input unit that receives a declination between the magnetic north at a present position of the body and the true north, wherein the azimuth calculator calculates the azimuth based on the declination (Col 6, lines 33-67 and Col 9, lines 17-35).

Regarding claims 11: Hansen et al. teaches a directional measuring device that measures a direction of a body of the directional measuring device in a three-dimensional space including an X-axis indicating magnetic north on a horizontal plane, a Y-axis orthogonal to the X-axis on the horizontal plane, and a Z-axis orthogonal to the horizontal plane, assuming that the body points towards an x-axis, comprising: first-axis geomagnetic force detector (11', 13') that detects a geomagnetic force along a first axis from among the x-axis, a y-axis that is orthogonal to the x-axis, and a z-axis that is orthogonal to both the x-axis and the y-axis; a second-axis geomagnetic force detector (11', 15') that detects a geomagnetic force along a second axis other than the first axis from among the x-axis, the y-axis, and the z-axis; a y-axis geomagnetic force detector (11', 15') that detects a geomagnetic force along a y-axis that is orthogonal to the x-axis; a z-axis geomagnetic force detector (11', 17') that detects a geomagnetic force along a z-axis that is orthogonal to both the x-axis and the y-axis; a y-axis tilt angle detector (33, 37) that detects a y-axis tilt angle that is an angle between the horizontal plane and the y-axis; a total geomagnetic force input unit (31, 25') that receives a total geomagnetic force at a present position of the body, wherein the total geomagnetic force is a vector addition of geomagnetic forces along the X-axis, the Y-axis, and the Z-axis (Col 7, line 41-Col 8, line 20); a geomagnetic force calculator that

calculates a geomagnetic force along an axis other than the first axis and the second axis, from among the x-axis, the y-axis, and the z-axis based on the total geomagnetic force and the geomagnetic forces along both the first and the second axis (Col 9, lines 9-35); an x-axis tilt angle detector (33, 35) that detects an x-axis tilt angle that is an angle between the horizontal plane and the x-axis; a determining unit that determines the x-axis tilt angle as a rotation angle that is an angle by which the x-axis needs to be rotated around the Y-axis so as to be in the horizontal plane; a rotation angle calculator (Fig. 10) that calculated a rotation angle based on the x-axis tilt angle and the y-axis tilt angle, wherein the rotation angle is an angle by which the y-axis needs to be rotated around the X-axis so as to be in the horizontal plane when the x-axis is rotated by the x-axis by the x-axis tilt angle around the Y-axis so as to be in the horizontal plane to cause the y-axis to rotate following rotation of the x-axis (Fig. 9), and an azimuth calculator (25', Fig. 10) that calculates an azimuth of the body based on the geomagnetic force and the rotation angle, wherein the azimuth calculator calculates an azimuth of the body based on the geomagnetic forces detected by both the y-axis geomagnetic force detector and the z-axis geomagnetic force detector and the rotation angle calculated, and the rotation angle calculator calculates the rotation angle based on a coordinate expression for rotations three times expressed by an expression wherein $\alpha$ is a rotation angle around the X-axis, $\beta$ is an x-axis tilt angle as a rotation angle around the Y-axis, and $\theta$ is a rotation angle around the Z-axis as an azimuth of the body (Col 7, line 41-Col 8, line 20).

Regarding claim 12: Hansen et al. teaches a directional measuring device that measures a direction of a body of the directional measuring device in a three-dimensional space including an X-axis indicating magnetic north on a horizontal plane, a Y-axis orthogonal to the X-axis on the horizontal plane, and a Z-axis orthogonal to the horizontal plane, assuming that the body points

towards an x-axis, comprising: a first-axis geomagnetic force detector (11', 13') that detects a geomagnetic force along a first axis from among the x-axis, a y-axis that is orthogonal to the x-axis, and a z-axis that is orthogonal to both the x-axis and the y-axis; a second-axis geomagnetic force detector (11', 15') that detects a geomagnetic force along a second axis other than the first axis from among the x-axis, the y-axis, and the z-axis; a total geomagnetic force input unit that receives a total geomagnetic force at a present position of the body, wherein the total geomagnetic force is a vector addition of geomagnetic forces along the X-axis, the Y-axis, and the Z axis (Col 7, line 41-Col 8, line 20); a geomagnetic force calculator (11', 17') that calculates a geomagnetic force along an axis other than the first axis and the second axis, from among the x-axis, the y-axis, and the z-axis based on the total geomagnetic force and the geomagnetic forces along both the first axis and the second axis; an x-axis tilt angle detector (33, 35) that detects an x-axis tilt angle that is an angle between the horizontal plane and the x-axis; a y-axis tilt angle detector (33, 37) that detects a y-axis tilt angle that is an angle between the horizontal plane and the y-axis; a rotation angle calculator (Figs. 9, 10) that calculates a rotation angle based on both the x-axis tilt angle and the y-axis tilt angle, wherein the rotation angle is an angle by which the y-axis needs to be rotated around the X-axis so as to be in the horizontal plane when the x-axis is rotated by the x-axis tilt angle around the Y-axis so as to be in the horizontal plane to cause the y-axis to rotate following rotation of the x-axis (Figs. 9-12); and an azimuth calculator (25') that calculates an azimuth of the body based on the geomagnetic forces along the y-axis and the z-axis and the rotation angle (Figs. 9-12), wherein the rotation angle calculator calculates the rotation angle based on a coordinate expression for rotations three times expressed by an expression wherein $\alpha$ is a rotation angle around the X-axis, $\beta$ is an x-axis tilt angle as a

rotation angle around the Y-axis, and θ is a rotation angle around the Z-axis as an azimuth of the body (Col 7, line 41-Col 8, line 20).

Regarding claims 13, 15, 17-19, and 21-24: Hansen et al. teaches the directional measuring device as described above for claims 1, 3, 5, 7, 9-12. The method of measuring the direction of a body of the directional measuring device in a three-dimensional space, as described in claims 13, 15, 17-19, 21-24, is performed by the device of Hansen et al. as above for claims 1, 3, 5-7, 9-12.

Regarding claims 25-28: Hansen et al. teaches the directional measuring device as described above for claims 1, 3, 5-7, 9-12. The computer program that realizes on a computer, a directional measuring method of measuring the direction of a body of the directional measuring device in a three-dimensional space as described in claims 25-28, is performed by the device of Hansen et al. as above for claims 1, 3, 5-7, 9-12.

## *Response to Arguments*

5. Applicant's arguments filed June 8, 2005 have been fully considered but they are not persuasive.

Regarding Applicant's argument that the subject matter of the previous claim 4, the rotation angle calculated based on a three-rotation coordinate expression is not found in Hansen et al. is not persuasive. Hansen et al. discloses the same matrices found in the body of the previous claim 4, now amended to be in all of the independent claims, in Col 7, line 41-Col 8, line 20. Hansen et al. teaches a rotation around the x-axis, "roll"; a rotation around the y-axis, "el"; and a rotation around the z-axis, "az". Since the matrices are the same, Examiner asserts that Hansen et al. does in fact teach calculating the rotation angle based on a three-rotation

coordinate expression. The order of the expression is also the same as Applicant's, as seen in Col 7, line 55 of Hansen et al. (Equation 2), $\bar{A} = \bar{A}_{roll} * \bar{A}_{el} * \bar{A}_{az}$.

***Conclusion***

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Amy R. Cohen whose telephone number is (571) 272-2238. The examiner can normally be reached on 8 am - 5 pm, M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego F. Gutierrez can be reached on (571) 272-2245. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ARC
August 17, 2005

Christopher Fulton
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